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THE COST OF AGRICULTURAL LIME
IN CONNECTICUT.

BY E. H. JENKINS AND J. P. STREET.

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The Cost of Agricultural Lime in Connecticut.

By E. H. JENKINS AND J. P. STREET.

The object of this bulletin is to answer the questions which are constantly asked us during the late winter and spring about the quality and price of agricultural lime and where to get it.

In the latter part of December our sampling agent visited the kilns of western Connecticut and carefully took samples of the lime which was in stock and ready to ship for agricultural use. These samples were analyzed by C. B. Morison of this station.

The names of the firms offering it and the analyses and prices are given below.

GROUND LIMESTONE.

1662. (ten mesh) Stearns Lime Co., Danbury.
1660. (forty mesh) " " " "

QUICK LIME, GRANULATED.

1659. New England Lime Co., Danbury. (Made at Adams, Mass.)

HYDRATED LIME, WATER-SLAKED, SPECIAL PROCESS.

1657. New England Lime Co., Danbury, New Milford kiln.

AIR-SLAKED LIME.

1666. Canaan kiln; New England Lime Co., Danbury.
1667. East Canaan kiln; " " " "
1663. Redding kiln; " " " "
1661. (second grade*) Stearns Lime Co., "
1669. Connecticut Lime Co., East Canaan.
1670. Sold by Olds & Whipple, Hartford. (From Cheshire Lime Co., Farnams, Mass.)

* The first grade was not in stock.

ANALYSES OF LIMESTONE AND LIME.

Station No.....	Ground Limestone		Quick Lime	Slaked Lime						
	1662	1660	1659	1657	1666	1667	1663	1661	1669	1670
Lime	45.56	46.38	90.66	45.64	42.70	42.66	50.00	68.94	49.32	65.12
Magnesia	2.18	3.26	0.96	30.40	29.02	28.56	33.66	2.80	33.02	0.72
Insoluble in acid .	....	....	1.77	1.15	1.51	3.32	1.35	20.16	0.58	1.27
Cost per ton*,										
in bulk	\$2.00	\$2.75	\$6.50	\$4.50	\$4.50	\$4.50	\$4.50	\$4.00	\$4.50	\$6.00†
in paper bags...	2.60	3.35	....	....	....	....	....	4.60	....	....
in burlap bags..	3.25	4.00	8.00	6.00	6.00	6.00	6.00	5.25	6.00	7.50†
Cost in cents per 100 lbs. lime-mag- nesia delivered at New Haven,										
in bulk	31.4	37.8	....	38.8	41.1	41.4	35.3	37.6	35.8	45.5
in paper bags...	37.7	43.8	....	....	....	....	....	41.8	....	....
in burlap bags..	44.5	50.4	....	48.7	51.6	52.0	44.2	46.3	44.9	57.0

The fineness of the grades of ground limestone is shown by the results of the siftings, as follows:

	1662 "ten mesh"	1660 "forty mesh"
Finer than 100 mesh	37 per cent.	46 per cent.
Between 100 and 80 mesh.....	1	4
" 80 " 50 " 	5	13
" 50 " 30 " 	8	17
" 30 " 20 " 	19	12
Coarser than 20 mesh	30	8
	<hr/> 100	<hr/> 100

In our opinion the "forty mesh" lime is a more desirable purchase, though the lime-magnesia costs about six cents more per one hundred pounds than the coarser lime.

These two analyses of ground limestone from the Stearns Lime Company represent the rock on which they are now working near the surface. The company states that it has even purer limestone uncovered and will maintain a percentage of 87 per cent. combined carbonate, or its equivalent, which is 48.7 per cent. of lime. This would reduce by two or three cents per 100 pounds the cost of lime-magnesia in their product, as given in the table above.

* f. o. b. at kiln.

† Delivered.

The fineness of lime is not a matter of indifference. To neutralize any undue acidity of the soil is our first object and in many cases in this State the main object. Neither ground limestone nor slaked lime are freely soluble in the soil water. They are only gradually dissolved, and the rate of solubility, other conditions being equal, depends on the amount of surface of the particles exposed to the action of the solvents.

Roughly speaking, under like conditions, lime in particles $1/100$ of an inch in diameter offers twice the surface to solvents as the same weight of lime in particles $1/50$ of an inch in diameter and, other things being equal, is twice as quickly soluble.

The Stearns Lime Company sells a calcite lime, that is, one in which the amount of magnesia is relatively quite small, but most of the Connecticut lime is a magnesian or dolomitic lime containing, roughly stated, about three pounds of magnesia to four of lime. While heavy doses of caustic magnesia have proved injurious in some cases, in other cases magnesian limestones have been preferred to pure limestones for farm uses. In the present state of our knowledge and at the usual rate of liming we are justified in valuing lime and magnesia together and regarding the magnesian lime and calcite lime as equally valuable on the land, though if liming is repeated several times we recommend the use occasionally of calcite lime by itself, since lime is more extensively taken from the soil by the crops and by drainage than magnesia.

The special freight rate on ground limestone in car-lots from Danbury is \$1.00 per ton to points west of the Connecticut River and \$1.25 to more eastern points. The rates from Danbury, as well as from other places in the State, on burned lime are different for the several delivery points. It is \$1.40 per ton to New Haven, and for purpose of comparison we have calculated all costs delivered at this point.

The prices given in the table represent regular market quotations. Special terms in cases of large purchases, etc., may be slightly lower.

LIME-KILN ASHES.

These are mixtures of the ashes of wood used in roasting limestone with large amounts of fine lime which fall into the furnace from the roasting lime above. They therefore contain small

amounts of phosphoric acid and potash, as appears in the following analyses:

1665.	New England Lime Co.,	Canaan kiln; not under cover.
1668.	" " " "	East Canaan kiln; not under cover.
1658.	" " " "	New Milford kiln; under cover.
1664.	" " " "	Redding kiln.

ANALYSIS OF LIME-KILN ASHES.

Station No.	1665	1668	1658	1664
Lime	30.04	36.84	44.46	42.90
Magnesia	9.02	14.68	19.54	9.38
Insoluble in acid	2.82	4.15	1.30	2.44
Moisture	21.66	10.81	....	....
Phosphoric acid	0.99	1.11	1.31	1.99
Potash	4.22	1.09	2.00	6.60
Cost per ton,				
in bulk	\$4.50	4.50	8.00	8.00
in bags	6.00	6.00	9.00	9.00
Cost in cents per 100 lbs. of lime-				
magnesia in car-lots at New				
Haven*				
in bulk	19.5	39.5	52.0	21.0
" bags	38.6	54.1	59.8	30.6

The analyses show the large range in the composition of lime-kiln ashes. The smaller relative amount of magnesia in 1664 and the very high per cent. of potash indicate only a small admixture of lime with wood ashes. This abnormal composition makes it doubtful whether it represents the general run of the ashes.

The average amounts of phosphoric acid and potash in thirteen samples of lime-kiln ashes analyzed here in the last few years have been 2.07 per cent. of potash and 1.12 per cent. of phosphoric acid.

Attention is called to The Grangers' Lime & Marble Company, of Danbury, which expects about the first of April to put ground limestone on the car in bulk for \$1.50 per ton at their Massachusetts works, now under construction.

GROUND OYSTER SHELL LIME.

If as finely ground as limestone this material should be equally valuable for liming soils. It is a by-product in making shells for poultry and in the manufacture of plastering material.

* Allowing 4 cents per pound for phosphoric acid and $4\frac{1}{4}$ cents per pound for potash.

A sample from a heap of this by-product, lying out of doors, had the following composition:

Water	11.76
*Carbonate of Lime	73.46
Insoluble in acid	10.78
Other matters, by difference	4.00
	<hr/>
	100.00

Finer than 100 mesh	2 per cent.
Between 100 and 80 mesh	11
" 80 " 50 " 	14
" 50 " 30 " 	25
" 30 " 20 " 	17
Coarser than 20 mesh	31
	<hr/>
	100

This is too coarse for profitable use. It could, however, be easily ground to proper fineness.

The analyses given in this bulletin, made on samples taken with great care, represent quite fairly the average composition, but single car-loads may be expected to show some variations.

A sample of a car-load needs to be drawn from all parts of the car while unloading, these samples should be very thoroughly mixed together and a sample of at least a pint of the mixture taken for analysis.

The Station before undertaking an analysis must be assured that the sample has been properly drawn, otherwise injustice is likely to be done to buyer or seller.

Small samples of lime in various forms are often sent to the Station by prospective purchasers which have been forwarded to them by mail from the manufacturers. These as a rule cannot be analyzed.

They have every chance to dry out in transit and while they may fairly show the fineness of the product, they otherwise convey no further information than the manufacturer's statement or guaranty.

So much has been said and written regarding the use of lime that anything further is unnecessary in this bulletin, which aims only to inform buyers where they can buy in this State, what they can get and in a general way what they must pay.

* Actual lime 41.14.

We urge those who are liming their land to leave a strip unlimed, in order to show whether the liming has a striking effect, and to wait about final judgment for two or three seasons. The beneficial effects, while positive, may not be immediately seen.

We also suggest that less attention be paid to the statement that lime destroys the soil humus, and vastly more attention be given to the need of constantly putting vegetable matter, from which humus is made, into the soil in cover crops and green manures. A good supply of humus in the soil, its constant destruction by an active microbe life, and its constant replacement by vegetable matter are necessary to increased crop production. Modern research indicates that, to a very large extent, fertilizers, manures, green crops and tillage increase production above ground by quickening the microbe life within it.



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